"Arrange for Change" Interpreting the Science of Climate Change in National Parks

By John Morris

Two years ago, an education institute was convened by the National Aeronautic and Space Administration (NASA) that sought to blend the science of NASA with the communication expertise of the National Park Service. The Earth to Sky program drew together scientists and interpreters from both agencies to collaborate on specific interpretive products for use in the parks. Climate change was one of the first topics identified to benefit from the wealth of NASA scientific resources.

(Above) The "Blue Marble": Using a collection of observations, a seamless, true-color mosaic of our planet.

NASA Goddard Space Flight Center image

(Left) Wildland fire in Denali National Park and Preserve in 2005.

National Park Service photograph

When queried last year, few of Alaska parks addressed climate change in their formal programs, although most received questions about it from visitors. However, the parks do promote themes that address change as a part of their stories. Evidence for climate change is more obvious in the arctic than almost anywhere else on the planet. Given that, and the reality that we hear more and more about it every day in the media, discussing climate change will have universal appeal for our audiences. It seems inevitable that in the very near future, interpreters and resource specialists alike will need to respond to these questions about global climate change and its implications.

Informal interpretation can be challenging. Unlike formal programs, the visitor is in control of where an individual contact goes. Interpreters need to be prepared with a wealth of specific knowledge and be able to think fast, changing the content of their discussion as needed. With this challenge in mind, the Earth to Sky workgroup developed an interactive tool to help rangers prepare for these informal conversations. A database of potential responses for frontline supervisors and rangers was designed, providing a broad scientific background about climate change as well as practical applications for discussions with visitors. In addition, a traveling display and general "Climate Change in National Parks" brochure were developed. These can be borrowed by parks everywhere and used as catalysts for informal conversations. The science of changing climate is ready to be communicated, in ways visitors will understand and appreciate.

Climate Change is Happening

Warmer winters and longer, more intense melt seasons have increased the rate of glacial retreat in most of Alaska national parks *(OASLC 2005)*. Higher temperatures and changes to precipitation, especially during winter, have brought high mortality to the black spruce, in particular, by expanding infestations of bark beetles and carrying them to new ranges. Increasing sea level and the loss of sea ice has increased erosion in many coastal areas and is damaging structures and may threaten the loss of archeological sites *(USGS 2002)*. For years, parks have witnessed an increase in the frequency and duration of wildland fires. Recent studies have concluded that a changing climate, not previous fire-suppression policies or land-use changes, seems to be the major cause *(Westerling et al. 2006)*.

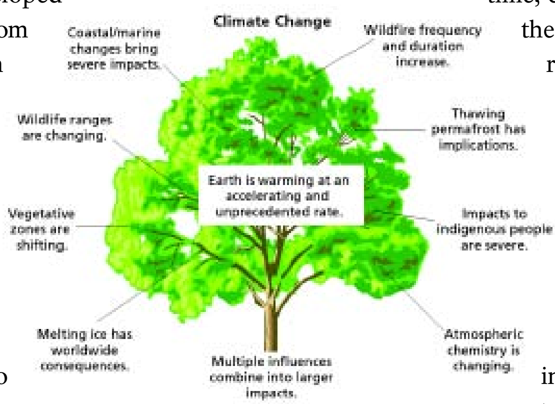
While many changes to park resources are inevitable, they can still influence the ways in which visitors use and enjoy the parks. Park closures are resulting from increased wildfires. Rising winter temperatures and reduced snow pack have halved the length of time each year in which arctic travel is feasible *(ACIA 2004)*. Salmon and trout populations, popular for fishing, are showing high mortality rates due to warming water and flooding *(EPA 1999, O'Neal 2002)*. Indigenous users of these fisheries are at risk to lose not only a food source, but a way of life. Many of these impacts have economic implications.

What the Science Tells Us

Scientists who study climate change agree that human activities are a big part of the current warming trend. As stated in the 2007 report of the Intergovernmental Panel on Climate Change, "Most of the observed increase in globally averaged temperatures since the mid-twentieth century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations" *(IPCC 2007)*. At Mauna Loa in Hawaii and around the world, specific evidence has been gathered of an increase in greenhouse gases in the atmosphere, predominantly carbon dioxide, which is contributing to the warming of the planet *(Keeling 1978)*. CO_2 levels in the atmosphere today are higher than they have been in over 650,000 years *(RealClimate 2005)*. For our national parks to thrive and for us to continue enjoying them, it seems appropriate now to do what we can to reduce climate change impacts and adapt to their consequences. NASA scientists remind us that fortunately, we now have the tools, knowledge, and ingenuity to better understand these changes and make informed choices for coping with them. They tell us that our own survival may be at stake *(Hansen 2006)*.

A Tool for Communicating About Climate Science

Efforts are now underway to educate park visitors about many of these changes. For the last year, rangers throughout Alaska have been asked to keep track of the specific questions already being asked about climate change by visitors at their sites. A range of possible responses was developed for each question, from basic orientation to more in-depth information, to responses that might facilitate an educational experience for the visitor. Once defined, responses were sorted into categories and annotated with specific source materials and multiple examples of appropriate techniques to use. Categories were based on the key findings of the Arctic Climate Impact Assessment *(2004)*.



A Climate Change Decision Tree.

The Decision Tree

Imagine climate change as a tree, each of its branches representing an implication of changing climate, and each of the leaves on the branches representing the questions visitors are asking about it. Here's an example of how these multiple responses work for one question:

Are These Changes Just the Result of Natural Variability?

Basic response: Current research reflects a scientific consensus that the climate changes experienced today cannot be attributed to natural variability alone *(ACIA, IPCC)*. In the past 125 years, the average temperature of the planet has begun to rise and the increase is accelerating. At the same time, carbon dioxide in the atmosphere has risen to its highest concentrations in more than 650,000 years, with its rise also accelerating. Scientists suspect this may be interfering with the Earth's natural balancing that has occurred prior to now.

In-Depth response: It is important to understand that at many times in Earth's geologic history, there have been cooler and warmer periods than at present. Besides human activities, variations are due to large scale global influences such as volcanism and meteor impacts. These charts help provide a fundamental understanding of Earth's paleo-history of recent times.

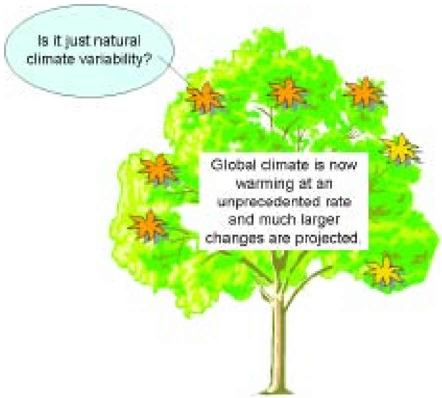
As the ranger illustrates and explains these charts, opportunities should arise for the visitor to gain new perspectives and perhaps, feel amazement at the long-term records we have for climate on Earth.

Interpretive response: After covering the charts about paleo-history, the interpreter could ask the visitor what they imagine might have caused the abrupt changes found to exist in those records. What are some possible catalysts? The intent for this response is to help them discover for themselves how changes in the atmosphere might create big impacts. Ultimately, the discussion should try to inspire them to wonder what could be done to solve the CO_2 problem and adapt.

Here's how

First, an experiment *(Bindschadler 2005)*: (the interpreter can do it or suggest it—whichever is most appropriate)

Take an ice cube and place it on a table at room temperature. If its temperature is measured before and after the ice cube melts, notice it stays the same, 32°F (0°C). Even though a lot of energy is needed to convert the ice to a liquid, the temperature does not change. Consequently, the energy needed to melt ice can be easily overlooked. If you heat the same quantity of water, applying the same amount of energy, its temperature would rise to 176°F (80°C). The point of this experiment is this: Ice near its melting point may be at a "tipping point"—a threshold where a lot of energy is going into the system, and the effects are not apparent until a critical level is reached. Once crossed, they are difficult to reverse. Is it possible that a similar tipping point



The Model – Question and Responses.

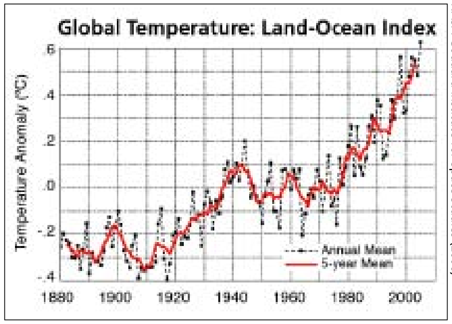
may be approaching for Earth?

Next, ask visitors if there is anything affecting the parks that might provide a clue as to why and when these tipping points might occur? What about the sun? In the early twentieth century, a Yugoslavian astronomer and mathematician provided an answer to what causes ice ages. Milutin Milankovitch recognized that minor changes in Earth's orbit around the sun and in the tilt of Earth's axis causes slight but important variations in the amount of solar energy that reaches any given latitude on the earth's surface. By reconstructing and dating the history of climatic variations over hundreds of thousands of years, scientists have shown that fluctuations of climate on glacial-interglacial time scales match the predictable cyclic changes in Earth's orbit and axial tilt. This persuasive evidence supports the theory that these astronomical factors control the timing of glacial-interglacial cycles.

Finally, ask the visitor what comprises air? Explain that greenhouse gases like CO_2 make up only about 1% of the atmosphere, so what would be the logical consequence of pouring lots more CO_2 in the atmosphere? Illustrate for them the modeling data from the IPCC, reflecting how anthropogenic and natural variability are needed to produce the warming effects being observed today.

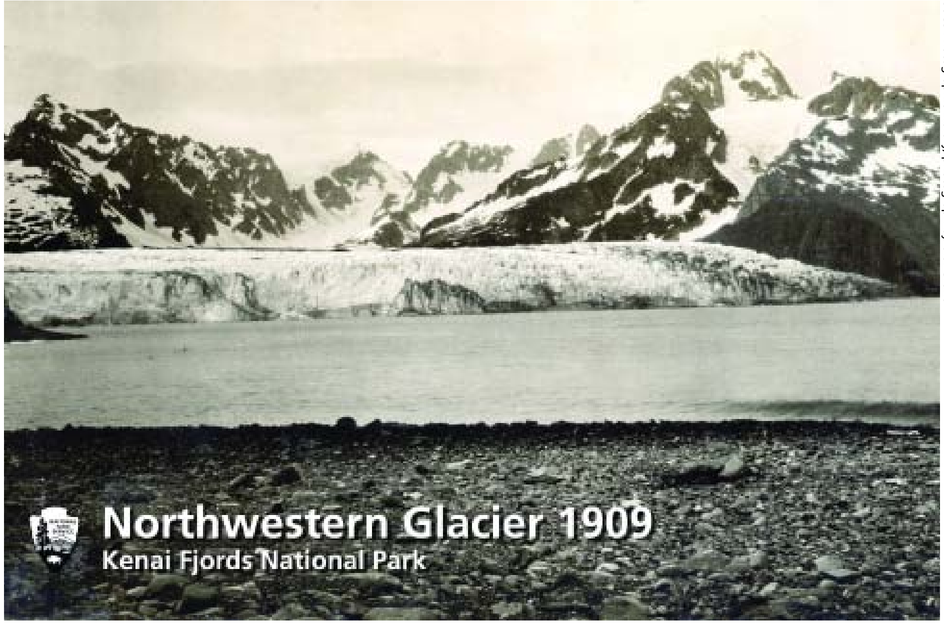
A Compelling Message of Hope

National parks are responding to these changes. Glacier Bay recently hosted a "Climate Friendly Parks" workshop, co-sponsored by the Environmental Protection Agency, to evaluate energy use and identify efficiencies to improve park operations. Other parks are developing solar and wind energy, fuel cells, electric and hybrid forms of transportation, and mass transportation where high visitation exists. Vulnerable resources are being monitored in many Alaska parks and several have researchers who are specifically addressing climate change impacts. With the development of this training tool, rangers in many parks are

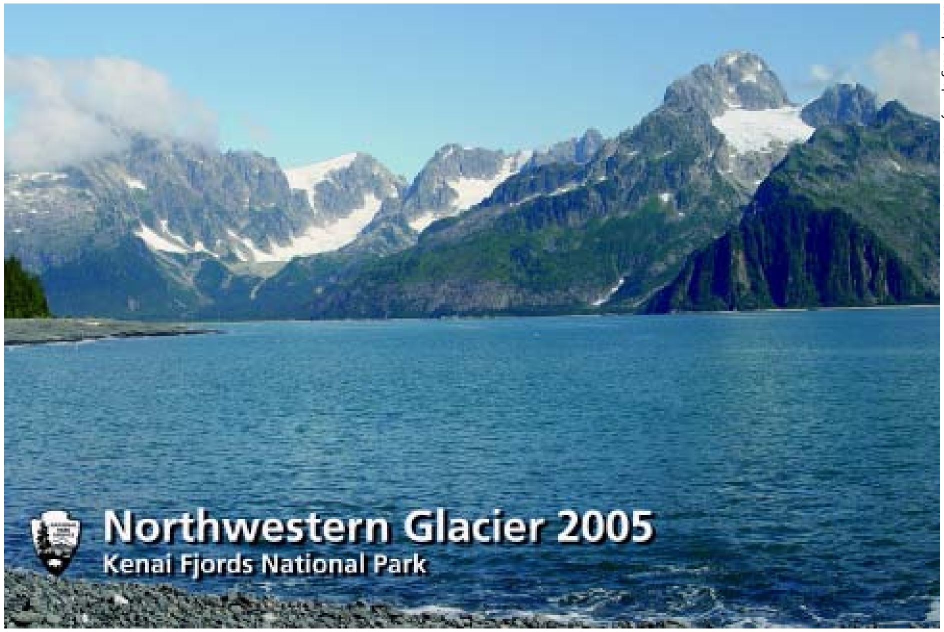


NASA Goddard Institute for Space Studies (2006)

A line plot of global annual-mean surface air temperatures derived from the meteorological station network.

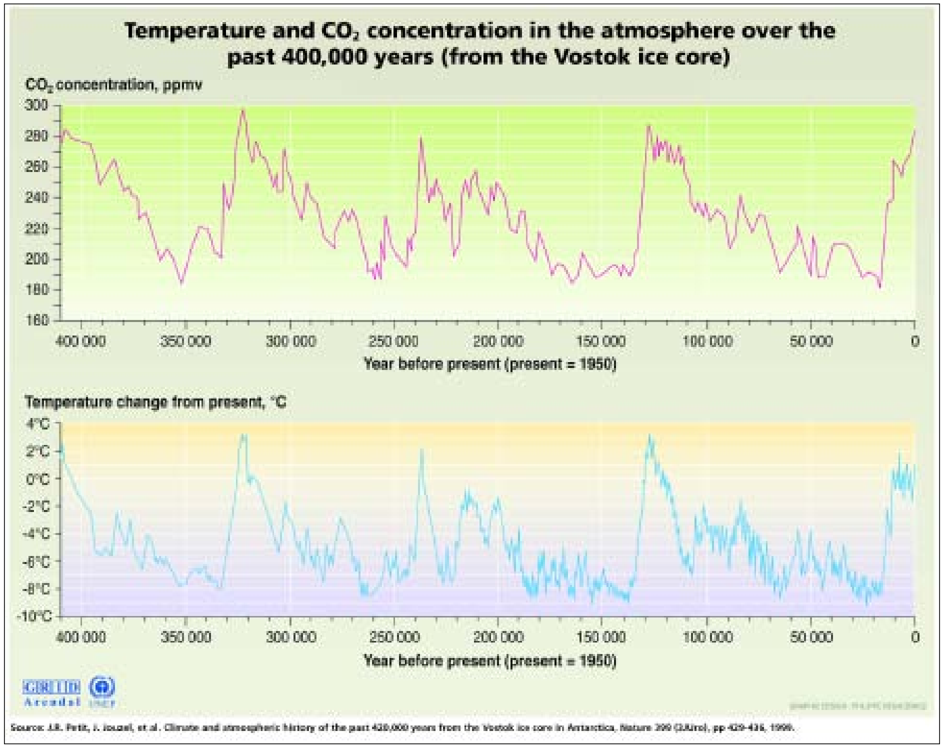


USGS Photographic Library, photograph by U.S. Grant



USGS photograph by Bruce F. Molnia

Glaciers are melting—Could it be that a "tipping point" is approaching for Earth?

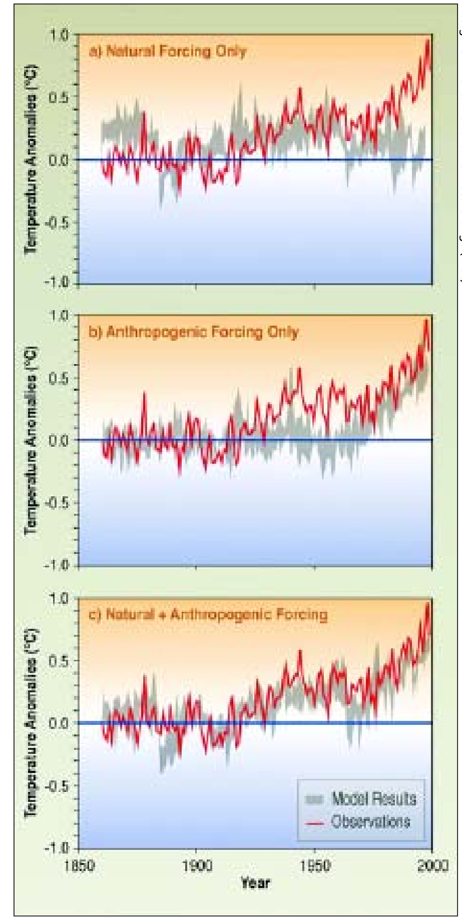


Temperature and CO_2 concentration in the atmosphere over the past 400,000 years. In UNEP/GRID-Arendal Maps and Graphics Library. Retrieved December 16, 2006 from http://maps.grida.no/go/graphic/temperature_and_co2_concentration_in_the_atmosphere_over_the_past_400_000_years.

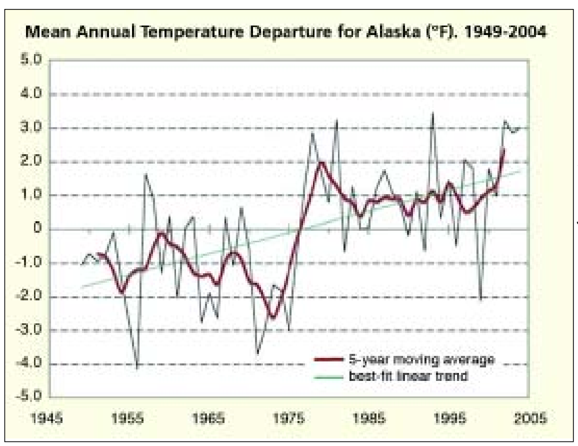
being prepared with the latest information about climate science in order to answer questions and assist visitors in understanding climate change and its implications. Their message can be one of hope.

Two scientists at Princeton published a paper describing how we already possess the technologies needed to reduce the abundance of CO_2 and outlining strategies to do so within 50 years *(Pacala and Socolow 2004)*. Many of their suggestions involve choices that individuals can make to conserve and reduce energy use. Changing to energy efficient light bulbs and appliances, unplugging computers and electronic devices when they’re not in use, and using public transportation are good examples of conservation practices. There are many more.

Many times during our nation’s history, citizens have confronted difficult circumstances and found creative solutions. Our national parks tell compelling stories about the American Revolution, the abolition of slavery, the fight for civil rights, and about countless inspirational personalities who have made a difference for our nation. Many parks even convey stories about people’s responses over thousands of years to shifting climate patterns. These stories are now part of a call to action for all visitors in the stewardship of our resources for future generations. Rangers can emphasize the importance of all participating in answer-



The red line indicates how actual temperature observations compare to modeled temperature results for natural and human caused influences on global climate.



Thomas Jefferson once said “To possess facts is knowledge, to use facts wisdom, to choose facts education.” The challenge of good interpretation is in choosing and creating compelling opportunities for visitors to make their own connections with the significance of park resources. If successful, interpreters facilitate memorable experiences that inspire new insights about the resources and evoke appreciation for the meanings they represent.

(Left) The red line shows 5-yr mean annual temperatures for the past 50 years in Alaska.

ing that call.

Regardless of the causes, taking action to manage the impacts of changing climate will have positive benefits for our resources. Parks are places where people learn what it means to be a responsible citizen and steward of community resources. In the future, national parks may tell the story of our collective success in dealing with climate change. What more compelling message is there for national parks to promote?

Here are a few basic websites of particular interest to climate change:

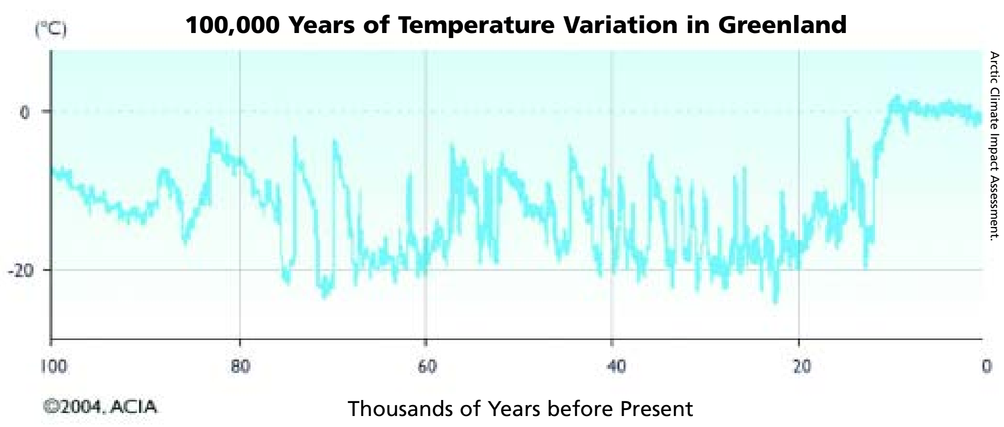
The Intergovernmental Panel on Climate Change
http://www.ipcc.ch/

The Arctic Climate Impact Assessment
http://amap.no/acia/ACIAContent.html

Understanding and Responding to Climate Change
http://dels.nas.edu/basc/Climate-HIGH.pdf

EPA's Global Warming—Actions
http://yosemite.epa.gov/oar/globalwarming.nsf/content/ActionsIndividualMakeaDifference.html

NPS/NASA Earth-to-Sky Interpretive Training tool on Global Climate Change
http://www.earthtosky.org



100,000 years of temperature variation based on ice-core analysis in Greenland.

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